Space Weather Technical Forecast

Issued on Friday 24 January 2025 at 12:19 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

---

Space Weather Forecast Headline: Chance of G2 period this UTC weekend.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Activity was at Low levels, with GOES16 registering declining magnitude occasional C-class activity, peaking with a C8.0 observed at 23/1636UTC from AR3961 in the southwest quadrant.

There are currently eight sunspot regions on the Earth-facing disc, with previous region AR3970 now faded. The largest, most active and nominally most complex region remains AR3961 in the southwestern quadrant. This group has shown a spreading trend and fading in its central and trailing portions, but there is now a possible weak Mt Wilson delta spot candidate developing in the ambit of the main penumbral leader, giving Eki/Beta-Gamma-Delta classification. The only other group to show any provisional delta is AR3972 in the south central disc, although its previous strong growth has now ceased. The final region of potential note is AR3971 in the northwest, which although has now plateaued in areal extent, shows some spot emergence in its Dai/Beta classifcation.

No new Earth-directed Coronal Mass Ejections (CMEs) have been confirmed - a jet-like emission from AR3961 at 23/1700UTC was linked with a faint, apparently mainly southwest-heading CME in Lasco C2, however this feature passes below and ahead of the Sun-Earth line to no anticipated effect. At the very end of the 24 hours, a long-period (and ongoing) C-class flare and probable CME was released from behind the oncoming eastern limb, again hinting at a possible arriving region here over the UTC weekend. No Earth effects are expected given the emission longitude.

Solar Wind / Geomagnetic Activity: Earth appears to be under the residual influence of the fast wind from CH09/-. The solar wind speed, as measured by ACE and DSCOVR at L1 persisted at Slightly Elevated levels, fluctuating about 450km/s +/-25km/s. The solar wind density was complicated according to which observing satellite was employed, but remained in single-figures ppcc. The IMF was weak, peaking at 7nT, with the north-south component varying between +5/-6nT. The phi angle was erratic but remained negative (towards the Sun).

The net result of the above solar wind measures was Quiet to Unsettled geomagnetic activity, with a provisional peak of 3+ in the 15-18 and 18-21UTC intervals.

Energetic Particles / Solar Radiation: High energy proton flux at GOES18 reverted to Background levels follwoing a very weak 10MeV enhancement (peaking below 1pfu) in the

© Crown Copyright 2025. All Rights Reserved.

previous 24-hour period.

High energy electron flux (greater than 2MeV) at GOES16 was Moderate to High, with a diurnal peak of 1920pfu seen at 23/1635UTC. The associated 24-hour fluence persisted below the Active threshold, reaching 5.47e7 integrated pfu at 24/0001UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: There is a daily Chance of isolated M-class flares, and a Slight Chance of X-class. The expected trend in risk is now slightly upwards.

Solar Wind / Geomagnetic Activity: Up to two CMEs may affect Earth in the period: firstly a 21 January M3-related CME, perhaps narrowly glancing 25/0600UTC; and secondly a potentially fuller glance from the 22 January M1- and filament-related CME, due 25/1800UTC. No new coronal holes feature in the forecast.

Initially Quiet conditions may give way to Chance of a period of peak G2 Moderate geomagnetic activity on day two, Saturday 25 January, waning over the ensuing UTC weekend to once again leave Quiet conditions into the final day of the period.

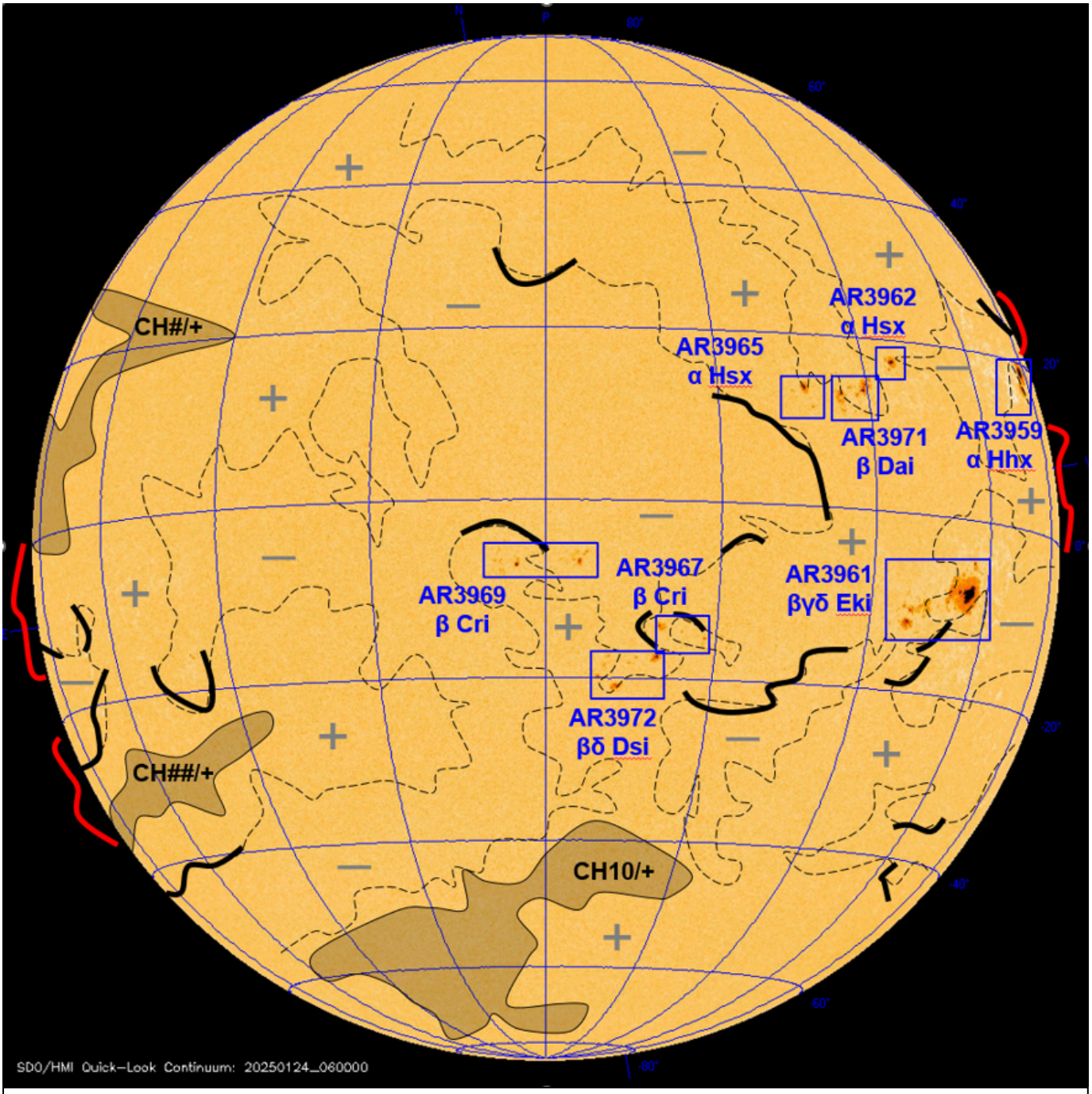
Energetic Particles / Solar Radiation: There remains a Slight Chance of enhancements exceeding the S1 Minor Radiation Storm threshold should any notable flares occur.

GOES16 high energy electron flux is forecast to continue at Moderate to High levels until any CME effects materialise, with a similar diurnal peak. The corresponding 24-hour fluence is expected to remain below the Active threshold.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2025. All Rights Reserved.

Figure 1: Latest solar synoptic map, valid 24/0600UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2025. All Rights Reserved.

Geomagnetic Storms

The only coronal hole to feature in the period is the current residual influence of CH09/-, with speeds still Slightly Elevated but much-reduced from their 21 January peak in the upper 600s of km/s. This residual influence is not expected to affect geomagnetic activity.

Currently two CMEs feature in the forecast - firstly that from an M3 from AR3967 on 21 January, and secondly a filament- and M1.3-related event near AR3961 from 22/1108UTC.

Of the CMEs, the first event is of lesser concern, being modelled in MOSWOC Enlil as a slight glancing blow early in the UTC day of Saturday 25 January. On its own, this might perhaps present a Slight Chance of G1, however it may be rendered more significant for any priming of the Earth's magnetosphere in advance of the later, more direct and larger event from the M1.3. This has been re-analysed as presenting a Chance of Moderate/G2 geomagnetic storms into the UTC evening of Saturday 25 January, with a full halo shock but with the dark helicoidal filament emission (in AIA304) perhaps appearing confined to the southern solar hemisphere (i.e. mainly below the Sun-Earth line).

MOSWOC Enlil is currently slightly over-estimating the speeds from the declining phase of CH09/-, which may slightly late-shift the inbound CMEs which otherwise cross 1AU around 25/0600UTC and then 25/1800UTC. The deterministic runs keep these as separate events, however there is a small chance that they coincide (as shown in the MOSWOC Enlil ensemble), which is the reason for the non-zero but not favoured risk of Strong G3. These probabilities then fade through the second half of the weekend (UTC) to leave a Quiet to Unsettled start to the forthcoming new working week.

Quiet to Unsettled activity expected at first may give way to a Chance of a Moderate G2 geomagnetic storm, most likely on 25 January. An alternative possibility would however see Quiet conditions remain in place throughout the four days - should both CMEs miss.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	40	30	1
Strong	G3	No	1	15	10	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

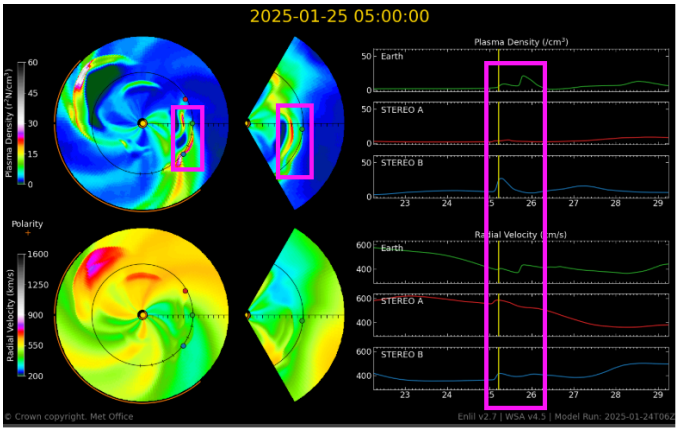
Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

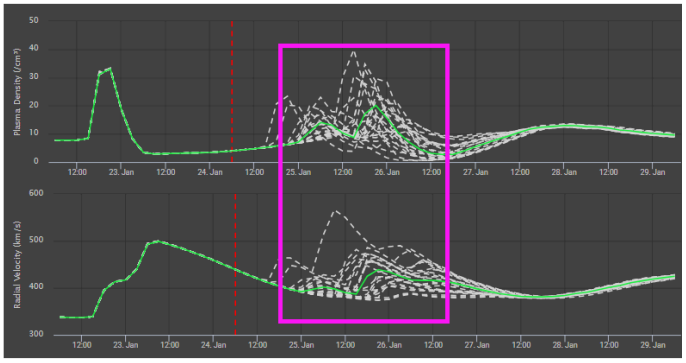
© Crown Copyright 2025. All Rights Reserved.

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R⊙ (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed (km/s)	Estimated Arrival Time (UTC)	Comments
21/1027	Partial	AR3967	SE	537	25/0600	Small chance of glance and G1, perhaps primes magnetosphere to increase impacts from later CME.
22/1727	Full	AR3961	S Centre	591	25/1800	Greater chance of glance relative to above, G2 most likely.

Figure 2: 24/0600UTC MOSWOC Enlil run and ensemble, paused at 1AU crossing time of the first of up to two inbound CME glances (boxed in magenta). The earlier originates from 21 January, and the later from 22 January. MOSWOC Enlil persists with its over-estimation of solar wind speed initial conditions, which may well mean that the interplanetary medium acts as more of a brake than in model space and these CMEs arrive slightly later than billed. Despite this, the main G2 risk is still felt to lie within Saturday 25 January (UTC).





© Crown Copyright 2025. All Rights Reserved.

Radio Blackouts - X-Ray Flares

The current Earth-facing disc is showing a westward bias in active region populations, with the far side conversely showing an eastward shift, i.e. diametrically opposite. This means that trends in the coming four-day forecast period will rely on a trade-off between the departure of AR3959 and any east limb arrivals, with the latter probably the larger factor given a series of CMEs emitted from what is now 90-100E during the UTC day of Thursday 23 Jaanuary. The current most active group, AR3961, will reach the west limb during day four (Monday 27 January). This has developed a recent penchant for discharging a series of small jet-like emissions and mid-ranking C-class flares, which may preclude any larger flares, however the leading group has perhaps developed a Mt Wilson delta in the period and any apparent decay should be treated with care. This may be the source of the larger C9.4 flare at the very end of the current 24-hour period.

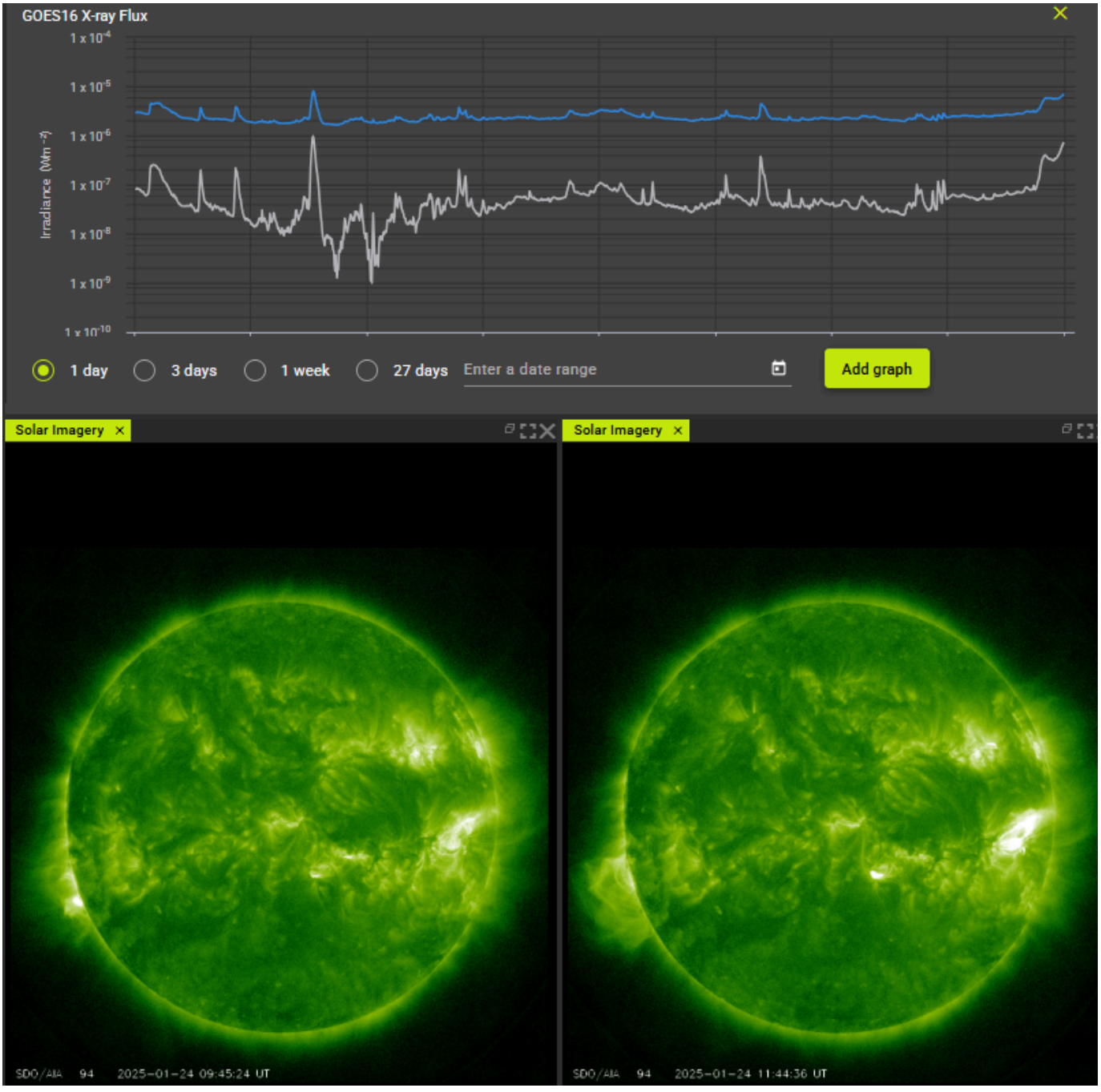
Overall, the daily risk of M-class flares has now been lowered to a Chance, but shows a slight rise into the weekend as the oncoming east limb region(s) more fully arrive(s). In this way, the risk from the slowing output from AR3961 may be helped back upwards by any new east limb arrivals.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	No	50	60	60	60
Very Active	R3-R5 (X Class)	No	5	5	5	5

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2025. All Rights Reserved.

Figure 3: GOES16 X-ray flux in past 24 hours and AIA094 detail of final flare event on the oncoming southeastern limb - perhaps a region to watch in the coming days.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

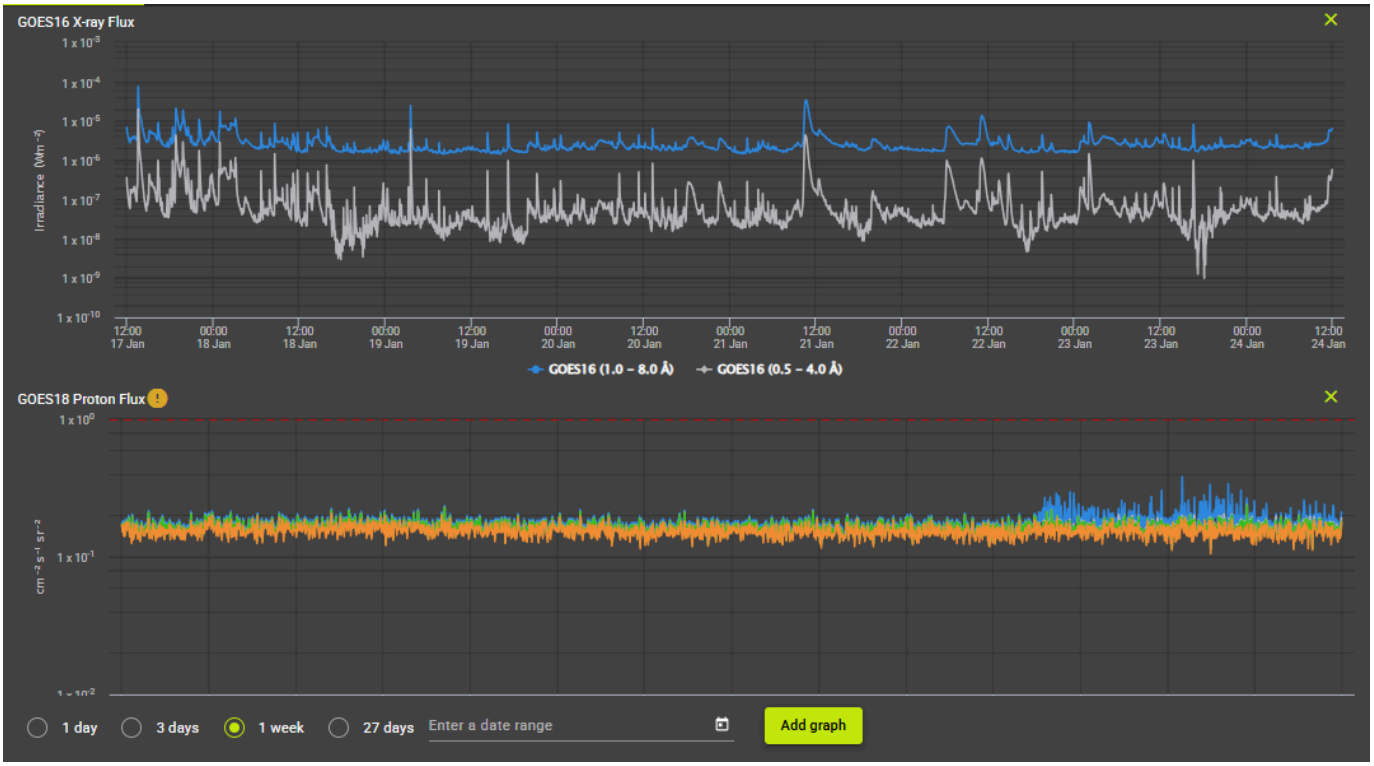
© Crown Copyright 2025. All Rights Reserved.

Solar Radiation Storms (High Energy Protons)

The recent very slight enhancement (less than 1pfu at peak) of 10MeV protons has not been repeated in the past 24 hours, and there is no additional risk to global probabilities of S1 or above from levels in the near-Earth environment. A slight day-on-day increase in a Slight Chance of S1 is therefore suggested, given the westward advance of a westward-biased disc (in terms of sunspot population). This has been revised downwards a little in magnitude from recent thoughts given trends in flare risk and a lack of further minor enhancements.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	15	15
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: Past week in GOES16 X-ray flares and GOES18 high energy protons, showing a very minor uptick in the past 36 hours that has now largely reverted to earlier background levels. The source is unclear, but may be far-sided.



© Crown Copyright 2025. All Rights Reserved.

High Energy Electrons (≥ 2MeV)

High energy electron flux observed at GOES16 has shown a recent diurnal peak of High flux. This has arisen from the declining phase of connection to CH09/-, with this driving feature now lying over western limb.

No further coronal holes due in the forecast period, and in the absence of further inputs, similar diurnally High levels are expected today and perhaps tomorrow, before any potential CME arrival(s). Thereafter, a rapid decline at GEO is expected, before a possible minor recovery late in the period with Moderate flux levels returning. However, confidence is low because of the uncertainly around the CME arrivals and their geomagnetic impact. In the possible alternative scenario of no CME effects, flux levels may instead show a gradual erosion of the current peak High flux through the whole period.

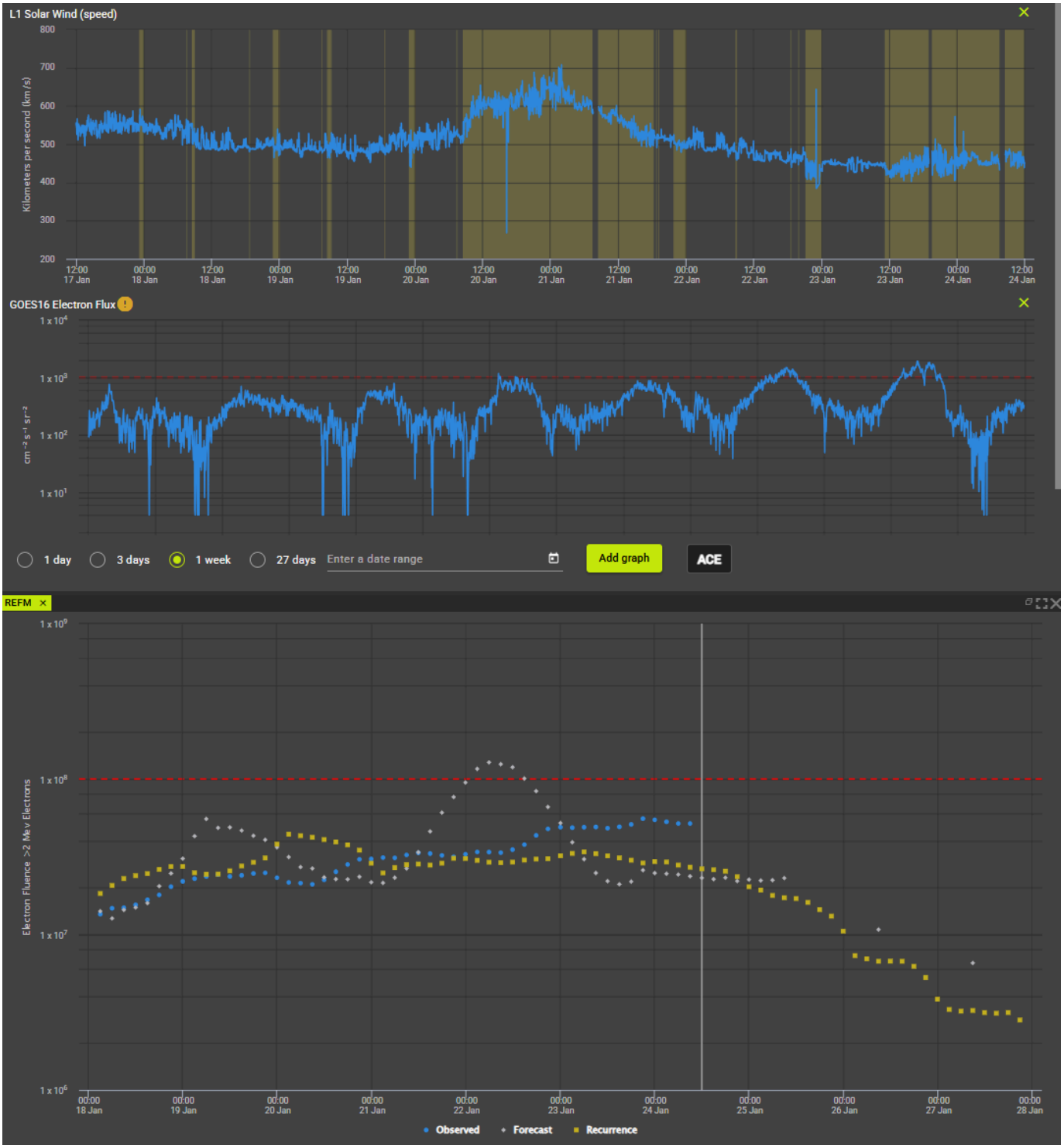
The corresponding 24-hour fluence is expected to remain below the Active threshold, with a gradual downward trend. MOSWOC REFM is felt to be reflecting this idea in the near-term, although its thoughts beyond any CME arrivals should be treated as the alternative case - i.e. a slow solar wind regime throughout.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	5	5	1	1
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2025. All Rights Reserved.

Figure 5: L1 solar wind speed as shown by DSCOVR and ACE, showing exit from recent CH09/- and a marginal effect at GOES16 on high energy electrons, with diurnal peaks creeping upwards to high. The blue dotted trace on the bottom MOSWOC REFM plot shows the relevant trend in fluence, with this appearing to stablilise before beginning a downward slide in the coming days - likely accelerated at GEO by any inbound CMEs (beyond the rate shown).



© Crown Copyright 2025. All Rights Reserved.